

### **Maintenance of Shoulder Health Research Study**

The purpose of this SCI Model System research study is to determine if a simple shoulder home exercise program can prevent shoulder pain in persons with spinal cord injury. The prevalence of shoulder pain for persons with spinal cord injury is 30-70% and is typically due to rotator cuff injury. The goal of this study is to protect the shoulder from injury and preserve shoulder strength and function. We plan to recruit 116 volunteers with spinal cord injury (paraplegia or tetraplegia), between 2-20 years post injury with pain-free shoulders. Volunteers are randomly assigned to one of two exercise training groups: one-to-one training with a physical therapist or group training sessions including education on methods to protect their shoulders during transfers and wheelchair activities with other volunteers, a peer mentor and a physical therapist. Volunteers are issued an exercise kit with exercise tubing and a hand weight. They are asked to perform the shoulder exercises as a home program 3 days per week. An odometer is installed on all manual wheelchairs to record wheelchair propulsion activity. Outcome measures include activity (frequency of performing exercise program, wheelchair propulsion, chores, walking), shoulder strength, self-efficacy and attitudes about exercise. Volunteers are followed for 3 years to evaluate the effectiveness of shoulder exercises to prevent the onset of shoulder pain and maintain shoulder health.

### **(Longitudinal study)\$1 Million NIH Grant Targets Shoulder Pain In Patients with Spinal Injuries**

Sara Mulroy, PT, PhD, Director of the Pathokinesiology Laboratory at Rancho Los Amigos National Rehabilitation Center, has been awarded a five-year, \$1.04 million grant from the National Institutes of Health's National Center for Medical Rehabilitation Research to study the risk factors for shoulder pain in patients with spinal cord injury. Mulroy said the most common diagnoses for people with spinal cord injury who have shoulder pain are inflammation and tears in the rotator cuff tendons of the shoulder. This pathology has been attributed to increased weight bearing on the arms during wheelchair propulsion, transfers in and out of the wheelchair and raising body weight on the arms to relieve pressure on the skin. Pilot studies by Mulroy and colleagues at Rancho Los Amigos suggest that the movement pattern an individual uses to propel a wheelchair can impact the risk of developing shoulder pain.

In the NIH-funded study, Mulroy and her colleagues will follow 320 subjects with paraplegia from spinal cord injury for a period of three years to determine the factors associated with shoulder pain. At the end of three years they compare the patterns of wheelchair propulsion, muscle strength and wheelchair activity levels in subjects who develop shoulder pain with those who remain pain-free.

The overall goal of the study is to develop recommendations to reduce the strain and joint deterioration that may occur with long-term weight bearing on the arms to prevent further loss of functional independence after spinal cord injury.

### **Interventions for SCI Shoulder Function in Wheelchairs (National Institutes of Health #RO1 HD37098)**

Following a Spinal Cord Injury, many individuals must rely on pushing a manual wheelchair for mobility. Better wheelchair designs and improved community accessibility have significantly increased work and recreational opportunities. Unfortunately, after many years of increased arm use, some persons develop disabling shoulder pain. In an attempt to reduce the demands placed on the shoulder during manual wheelchair propulsion, this project evaluates two therapeutic interventions: adjusting seating posture and exercise.

### **Engineering Solutions for a Shoulder Preserving Wheelchair (National Institute of Disability and Rehabilitation Research #H133E020732)**

The Engineering Solutions for a Shoulder Preserving Wheelchair project is being conducted in the Pathokinesiology Laboratory as part of a Rehabilitation Engineering Research Center (RERC): Keep Moving: Technologies to Enhance Mobility and Function for Individuals with Spinal Cord Injury (SCI). This project is designed to evaluate the effectiveness of alternative propulsion systems for reducing the demands associated with manual wheelchair use. This includes a lever design, power-assisted push-rim design, and compliant push-rim design. A combined approach using laboratory-based experimentation and computer modeling techniques will be used to develop specific clinical criteria for prescription of

currently available manual wheelchair propulsion devices. Upper extremity mechanical and muscular demands, and metabolic energy cost will be quantified from individuals with varying strength levels during wheelchair propulsion. Dynamic simulation, numerical optimization, and analysis techniques will be utilized to identify factors that may further reduce stress on the shoulder of individuals with SCI.

### **Strengthening and Optimal Movement for Painful Shoulders in Chronic Spinal Cord Injury “STOMPS”**

**(Foundation for Physical Therapy and National Institute of Disability and Rehabilitation Research #H133B031002-04)**

The STOMPS project is being conducted as part of a clinical research network in collaboration with the Department of Biokinesiology and Physical Therapy at the University of Southern California. This clinical investigation is designed to evaluate the efficacy of an exercise program on shoulder pain in persons with paraplegia following spinal cord injury and chronic shoulder pain. Participants were randomly assigned to receive either a 12-week home exercise program or education about shoulder care. Pre- and post-intervention evaluations, performed at the Pathokinesiology Laboratory, evaluated shoulder function, pain, and activity level.

Persons who performed the simple shoulder home exercise program reported a significant decrease in shoulder pain, improved quality of life, and greater shoulder strength compared to persons who received education about shoulder care. These results suggest that a simple shoulder home exercise program can greatly reduce chronic shoulder pain.

### **Scapular Biomechanics and Shoulder Pain in Wheelchair Users with SCI**

**(Craig H. Nielson Foundation Pilot Research Grant)**

This study is being conducted in the Pathokinesiology Laboratory. The overall objective of this study is to identify whether altering hand placement during wheelchair propulsion and car transfer, crucial and high demand activities, can help prevent shoulder pain development by individuals who use a manual wheelchair and have spinal cord injury. In particular, we are evaluating for application through the upper extremity, glenohumeral and scapular motion (kinematics) and shoulder muscle activity during these activities in attempts to determine whether different techniques compress the subacromial space and increase risk for shoulder impingement during these activities. We aim to evaluate a total of 20 individuals each with paraplegia and tetraplegia, without substantial shoulder pain or pathology, with a duration of spinal cord injury of at least 2 years who regularly perform depression transfers independently and drive.